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TN 124 DISCUSSION

Engineering responsibilities of stress analysis by computer

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It is unfortunate that computing is still something of a glamour industry and engineers tend to embark on sophisticated computer analyses with little forethought and planning, or access to independent, professional advice. The warnings given in Dr Abdelmigid's article cannot be overstressed.

12. When the Association for Computer Aided Design (ACADS) was founded in Australia in 1970, its initiators were particularly concerned that computers be used in a professional manner. As structural engineers they recognized that computing aids could be very useful in their work but were aware that no industry standards existed and that computing was often oversold.

13. Of particular relevance to TN 124 is the ACADS policy document 74/1: *Recommended standard for documentation and checking of computer aided engineering computations*. This document is referenced in the draft of the Uniform Building Regulations in the State of Victoria, Australia. It has also been used by bodies elsewhere as a basis for standards. ACADS has also published a report comparing the accuracy and reliability of several frame analysis programs.

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The Note reiterates sound procedures which an engineer should follow if he proposes to use a computer based system for stress analysis or any type of engineering application developed by a different organization than the one to which he belongs. Although the proposals are in general perfectly acceptable, it is necessary to emphasize 'different organization', for the proposals would be unnecessary and economically wasteful if used by an engineer to test programs developed by professional colleagues.

15. For a computer program developed by an outside agency, it is absolutely essential for it to have comprehensive testing and proving, and it is certainly true that an engineer must understand the principles and techniques on which it is based if he is to be responsible for the final design. However, the implications of § 2, that an engineer must understand the principles of computing, is unacceptable. Many programs[3,4] are extremely sophisticated and complicated and therefore the engineer cannot, nor should he, think it a prerequisite for use of a program to understand the details of computing—computing is a highly demanding profession and for the practising engineer it is not essential that he develops skills in this discipline because there are so many other calls on his time.

16. It is not necessary to complete all the tasks suggested by the Author. Program verification is expensive and therefore the degree of testing must be related to the

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engineering risk and to the anticipated use of a program. In order to minimize on testing costs whilst ensuring reliability, organizations may pool resources or may rely on extensive tests undertaken by official bodies such as Loughborough University of Technology[5] which was heavily involved with program testing in the 1960s in the manner described by the Author, or the National Computing Centre which has continued some of the work started by Loughborough. However, for the medium-size organization it would not be economically viable to undertake the full sophistication of laboratory and field testing proposed. This can only be made by research bodies similar to those indicated above, or by Government bodies with large financial resources. For example, the Highway Engineering Group's Computer Branch of the Department of the Environment undertakes this type of testing but only for large important programs. The method of testing must reflect the importance of the program and the use to be made of it.

17. The proposals of § 7 refer to the writing of programs for oneself, for which the procedures are infinitely more complex than verifying other party's work; of all computer involvement, this is the most costly.[4] In § 4 it is proposed that the results of similar programs should be compared. This may be possible for structural analysis programs as completed by Loughborough, but for computer-aided design in its true and wider sense, as opposed to analysis, this may be impossible because there are so few programs available—as is the case of the design of reinforced concrete service reservoirs[4] or of reinforced concrete buildings[3] for each of which there is only one design program commercially available.

References

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